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[0051]

[Embodiments of the Invention]

(1) Description below is made about a first embodiment of the present invention with reference to the drawings. Here, the like portions as those in Figs. 10 to 12 and 17 are given the like numerals, and the detailed explanation thereof is omitted.

[0052]

Fig. 1 is a block diagram of the substrate check system equipped with a substrate transport device 3 and a substrate check device 1. There are two displacement detecting sensors 40 and 41 provided in the substrate check device 1. These displacement detecting sensors 40 and 41 are set spacing narrower than the width of the LCD substrate 2 over the approximately perpendicular direction to the transport direction when holding and transporting the LCD substrate 2 on the substrate transport robot's 6 left hand or the right hand 17, 20. Here, only the left hand 17 is shown in Fig. 1. These displacement detecting sensors 40 and 41 are provided for detecting the edge of the LCD substrate 2 transported and consist of a combination of a light emitting device and a photo detector or other detecting element detecting the position magnetically or electrically.

[0053]

Displacement computing means 42 receives detection signals outputted from the two displacement detecting sensors 40 and 41, and it has the function of obtaining from these detection signals based on the position of the edge of the LCD substrate 2, a displacement to the predetermined position of the LCD substrate 2 currently held on the left hand 17, i.e., position 33b where the LCD substrate 2 should be placed on the actually installed substrate check device 1.

[0054]

Position correcting means 43 has the function of receiving the displacement to the position 33b where the LCD substrate 2 should be placed on the actually installed substrate check device 1 obtained by the displacement computing means 42 and sending to the substrate transport robot 6 a correction command for correcting the position of the LCD substrate 2 currently held on the left hand 17 based on the displacement in such a manner that the LCD substrate 2 may be put on the position 33b where the LCD substrate 2 should be placed on the substrate check device 1.

[0055]

In addition, these displacement computing means 42 and the position correcting means 43 may be provided either to the side of the substrate check device 1

or to the side of the substrate transport device 3.

[0056]

Next description is made about an operation of the substrate check system configured as described above.

[0057]

First, the substrate transport robot 6 moves to the front of a cassette 4a which contains non-checked LCD substrates 2 by the operation of a horizontal moving device 8, extends the left transport arm 13 in the direction of the cassette 4a to take out a non-checked LCD substrate 2 and puts the left hand 17 into the bottom of the LCD substrate 2.

[0058]

Next, a rise-and-fall motor is driven to raise the left hand 17 for a while, the LCD substrate 2 is laid on the left hand 17, its left transport arm 13 is drawn in, and the LCD substrate 2 is brought from cassette 4a onto the substrate transport robot 6.

[0059]

Next, while the left transport arm 13 and the right transport arm 14 are rotated 180 degrees by rotational operation of a turning motor, the substrate transport robot 6 is moved to a longitudinal direction by the horizontal moving device 8, and the rise-and-fall motor is driven, and the height position of the right hand 20 is doubled with the height position of the stage 9 for substrate installation of substrate check device 1 at left hand 17 list.

[0060]

If the substrate transport robot 6 does horizontal moving and is positioned ahead of the substrate check device 1, this substrate transport robot 6 puts the right hand 20 for the right transport arm 14 into the bottom of the LCD substrate 2 in order to take out the LCD substrate 2 which is already checked in the substrate check device 1.

[0061]

Next, the rise-and-fall motor is driven to raise the right hand 20 for a while, the checked LCD substrate 2 is laid on the right hand 20, its right transport arm 14 is drawn in, and the LCD substrate 2 is brought from the stage 9 for substrate installation onto the upper part of the substrate transport robot 6.

[0062]

While this checked LCD substrate 2 is ejected, the substrate transport robot 6 advances the left hand 17 with the non-checked LCD substrate 2 on and lays the LCD substrate 2 on the stage 9 for substrate installation, and after that, the substrate transport robot 6 sets back the left hand 17 with nothing placed thereon.

[0063]

Thus, when advancing the left hand 17 to place the LCD substrate 2 on the stage 9 for substrate installation, the LCD substrate 2 currently held on the left hand 17 is subjected to position correction to the position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1.

[0064]

Operation of this position correction is explained with reference to Fig. 2 (a) - (e). In addition, only the left transport arm 13 is explained also here.

[0065]

The LCD substrate 2 currently held on the left hand 17 is held displaced toward the displacement detecting sensors 40 and 41 by the gap of the installation position of the cassette stand 30, difference in positions of LCD substrates 2 in the cassette 4a and a displacement of the position of the substrate check device 1 etc.

[0066]

If the substrate transport robot 6 extends the left transport arm 13, the front end of the LCD substrate 2 currently held on the left hand 17 as shown in Fig. 2 (a) comes to either of displacement detecting sensors 40, 41, for example, to the displacement detecting sensor 41 so as to go across the displacement detecting sensor 41. At this time, the displacement detecting sensor 41 detects the front end of the LCD substrate 2, and outputs that detection signal.

[0067]

The displacement computing means 42 inputs the detection signal outputted from the displacement detecting sensors 41, memorizes the include angle of the second arm 16 of the left transport arm 13 at this time, and computes the amount of gaps of the cross direction of the LCD substrate 2 based on this include angle.

[0068]

If the left transport arm 13 is extended further, the front end of the LCD substrate 2 currently held on the left hand 17 as shown in Fig. 2(b) goes across the arrangement position of the other displacement detecting sensor 40. At this time, the displacement detecting sensor 40 detects the front end of the LCD substrate 2, and outputs that detection signal.

[0069]

The displacement computing means 42 inputs the detection signal outputted from the displacement detecting sensor 40, memorizes the include angle of the second arm 16 of the left transport arm 13 at this time, and computes the inclination of the LCD substrate 2 based on the include angle of the second arm 16 when the displacement

detecting sensor 41 previously detects the front end of the LCD substrate 2, and the include angle of this second arm 16.

[0070]

The LCD substrate 2 currently held on the left hand 17 as the left transport arm 13 is further shown in elongation and Fig. 2 (c) comes to lap above the stage 9 for substrate installation. And the substrate transport robot 6 moves in a horizontal direction by actuation of the horizontal moving device 8. By this horizontal movement, the side edge of the LCD substrate 2 goes across the arrangement position of the other displacement detecting sensor 40. At this time, the displacement detecting sensor 40 detects the side edge of the LCD substrate 2, and outputs that detection signal.

[0071]

The displacement computing means 42 memorizes the horizontal moving distance to the substrate transport robot's 6, and computes the amount of gaps of the horizontal direction of the LCD substrate 2 based on this travel.

[0072]

The position correcting means 43 receives a displacement of the LCD substrate 2 to the displacement to position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1 obtained by the displacement computing means 42, that is, a displacement in the cross direction, inclination and a displacement in the longitudinal direction of the LCD substrate 2 and based on these displacement in the cross direction, inclination and displacement in the longitudinal direction of the LCD substrate 2, sends a correction command for correcting the position of the LCD substrate 2 currently held on the left hand 17 into the position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1 to the substrate transport robot 6.

[0073]

On receiving the correction command from the position correcting means 43, the substrate transport robot 6 does a correcting action so that the LCD substrate 2 currently held on the left hand 17 as shown in Fig. 2 (e) may be put on the position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1.

[0074]

Next, the substrate transport robot 6 rotates 180 degree and moves ahead of cassette 4b which contains the checked LCD substrate 2 by actuation of the horizontal moving device 8, and in order to put checked LCD substrate 2 into this cassette 4b, the substrate transport robot 6 extends the right transport arm 14 to put the LCD substrates

2 in cassette 4b. Then, its right transport arm 14 is drawn in.

[0075]

A series of the above-mentioned check operations of the LCD substrate 2 is repeated after this.

[0076]

Thus, in the above-described first embodiment, two displacement detecting sensors 40 and 41 are formed in substrate check device 1 and are used to detect the edge of the LCD substrate 2, based on which is computed a displacement of the LCD substrate 2 held on the left hand 17 from the position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1. Since this displacement is used as a basis to correct the position of the LCD substrate 2 so that it may put on the position 33b which the LCD substrate 2 should be placed, even if the magnitude of the LCD substrate 2 is enlarged with up-sizing of LCD and the weight becomes heavy, the possibility of pushing the LCD substrate 2 forcibly, moving it and breaking it can be eliminated, and therefore, the LCD substrate 2 can be directly and accurately put on the position on which the LCD substrate 2 should be placed on the stage 9 for substrate installation in the actually installed substrate check device 1. Thereby, in substrate check device 1, a highly precise check is attained for the LCD substrate 2.

[0077]

(2) Next description is made about a second embodiment of the present invention with reference to the drawings. Here, the like portions as those in Fig. 1 are given the like numerals, and the detailed explanation thereof is omitted.

[0078]

Fig. 3 is a block diagram of the substrate check system equipped with a substrate transport device 3 and a substrate check device 1.

[0079]

There are three displacement detecting sensors 50, 51 and 52 provided on two sides of the edge of the position 33b where the LCD substrate 2 should be placed on the stage 9 for substrate installation in the actually installed substrate check device 1. These displacement detecting sensors 50, 51 and 52 are provided for detecting the edge of the LCD substrate 2 held on the left hand 17 or right hand 20 and implemented with reflecting sensors or the like. These displacement detecting sensors 50, 51 and 52 may consist of a combination of a light emitting device and a photo detector or other detecting element detecting the position magnetically or electrically.

[0080]

Position correcting means 53 has the function of receiving detection signals output from the displacement detecting sensors 50, 51 and 52 and based on these detection signals, sending to the substrate transport robot 6 a correction command for correcting the position of the LCD substrate 2 currently held on the left hand 17 or right hand 17 so that the two sides of the LCD substrate 2 may be detected to be on the position 33b where the LCD substrate 2 should be placed on the actually installed substrate check device 1.

[0081]

Next description is made about an operation of the substrate check system configured as described above.

[0082]

First, the substrate transport robot 6 moves to the front of a cassette 4a which contains non-checked LCD substrates 2 by the operation of a horizontal moving device 8, extends the right transport arm 14 in the direction of the cassette 4a to take out a non-checked LCD substrate 2 and puts the right hand 20 into the bottom of the LCD substrate 2.

[0083]

Next, a rise-and-fall motor is driven to raise the right hand 20 for a while, the LCD substrate 2 is laid on the right hand 20, its right transport arm 14 is drawn in, and the LCD substrate 2 is brought from cassette 4a onto the substrate transport robot 6.

[0084]

Next, while the left transport arm 13 and the right transport arm 14 are rotated 180 degrees by rotational operation of a turning motor, the substrate transport robot 6 is moved to a longitudinal direction by the horizontal moving device 8, and the rise-and-fall motor is driven, and the height position of the left hand 17 and the height position of the right hand 20 are adjusted to the height position of the stage 9 for substrate installation of substrate check device 1.

[0085]

If the substrate transport robot 6 does horizontal moving and is positioned ahead of the substrate check device 1, this substrate transport robot 6 extends the left transport arm 13 and puts the left hand 17 into the bottom of the LCD substrate 2 in order to take out the LCD substrate 2 which is already checked in the substrate check device 1.

[0086]

Next, the rise-and-fall motor is driven to raise the left hand 17 for a while, the checked LCD substrate 2 is laid on the left hand 17, its left transport arm 13 is drawn in,

and the LCD substrate 2 is brought from the stage 9 for substrate installation onto the upper part of the substrate transport robot 6.

[0087]

While this checked LCD substrate 2 is ejected, the substrate transport robot 6 advances the right hand 20 with the non-checked LCD substrate 2 on, and places the LCD substrate 2 on the stage 9 for substrate installation, and after that, the substrate transport robot 6 sets back the right hand 20 with nothing placed thereon.

[0088]

Thus, when stretching the right hand 20 to place the LCD substrate 2 on the stage 9 for substrate installation, the LCD substrate 2 currently held on the left hand 17 is subjected to position correction to the position 33b which the LCD substrate 2 should be placed on the actually installed substrate check device 1.

[0089]

Operation of this position correction is explained with reference to Fig. 4 (a) - (d). In addition, only the right transport arm 14 is explained also here.

[0090]

The LCD substrate 2 currently held on the right hand 20 is held displaced from the position 33b which the LCD substrate 2 should be placed on the substrate check device 1 by displacement of the installation position of the cassette stand 30, difference in positions of LCD substrates 2 in the cassette 4a and a displacement of the position of the substrate check device 1 etc.

[0091]

If the substrate transport robot 6 extends the right transport arm 14, the edge of the LCD substrate 2, as shown in Fig. 4 (a) crosses any one of the displacement detecting sensors 50, 51 and 52, for example, the displacement detecting sensor 51. At this time, the displacement detecting sensor 51 detects the edge of the LCD substrate 2, and outputs that detection signal.

[0092]

The position correcting means 53 receives the detection signal from the displacement detecting sensor 50 and stores the position of the substrate transport robot 6.

[0093]

When the substrate transport robot 6 little further extends the right transport arm 14 little further, the edge of the LCD substrate 2 crosses another displacement detecting sensor 51. At this time, the displacement detecting sensor 51 detects the edge of the LCD substrate 2 and outputs a detection signal thereof.

[0094]

The position correcting means 53 computes a fine correcting amount based on the position of the substrate transport robot 6 obtained when the edge of the LCD substrate 2 was first detected by the displacement detecting sensor 50 and the position of the substrate transport robot 6 obtained when the edge of the LCD substrate 2 was second detected by the displacement detecting sensor 51, and sends it to the substrate transport robot 6.

[0095]

On receiving the correction command from the position correcting means 53, the substrate transport robot 6 does a fine correcting action to the rotational direction as shown in Fig. 4 (b).

[0096]

Next, the substrate transport robot 6 further extends the right transport arm 14 as shown in Fig. 4(c). Then, the edge of the LCD substrates 2 crosses the displacement detecting sensor 50 again. At this time, the displacement detecting sensor 50 detects the edge of the LCD substrates 2 and outputs a detection signal again.

[0097]

The position correcting means 53 receives the detection signal output from the displacement detecting sensor 51 and stops stretching out of the right transport arm 14 by the substrate transport robot 6.

[0098]

Next, the substrate transport robot 6 is moved to the horizontal direction by the horizontal moving device 8 as shown in Fig. 4(c) and then, the edge of the LCD substrates 2 crosses the displacement detecting sensors 51, 52. At this time, the displacement detecting sensors 51 and 52 detect the edge of the LCD substrates 2 and output detection signals. The position correcting means 53 receives the detection signals from the displacement detecting sensors 51 and 52 and stops horizontal movement of the substrate transport robot 6 by the horizontal moving device 8.

[0099]

In this way, the substrate transport robot 6 operates the right transport arm 14 as shown in Fig. 4(d) and places the LCD substrates 2 held on the right hand 20 onto the position 33b where the LCD substrate 2 should be placed in the actually installed substrate check device 1.

[0100]

Next, the substrate transport robot 6 rotates 180 degree and moves ahead of



cassette 4b which contains checked LCD substrates 2 by actuation of the horizontal moving device 8, and in order to put checked LCD substrate 2 into this cassette 4b, the substrate transport robot 6 extends right transport arm 14 to put the LCD substrates 2 in cassette 4b. Then, its right transport arm 14 is drawn in.

[0101]

A series of the above-mentioned check operations of the LCD substrate 2 is repeated after this.

[0102]

Thus, in the above-described second embodiment, three displacement detecting sensors 50, 51 and 52 are formed at two sides of the position where the LCD substrate 2 should be placed on the stage 9 for substrate installation in the actually installed substrate check device 1 and are used to detect the edge of the LCD substrate 2, based on which the position of the LCD substrate 2 held on the right hand 20 is corrected so that the two sides of the LCD substrate 2 may be detected on the position 33b which the LCD substrate 2 should be placed in the actually installed substrate check device 1. Accordingly, like in the above-described first embodiment, even if the magnitude of the LCD substrate 2 is enlarged with up-sizing of LCD and the weight becomes heavy, the possibility of pushing the LCD substrate 2 forcibly, moving it and breaking it can be eliminated, and therefore, the LCD substrate 2 can be directly and accurately put on the position on which the LCD substrate 2 should be placed on the stage 9 for substrate installation in the actually installed substrate check device 1. Thereby, in substrate check device 1, a highly precise check is attained for the LCD substrate 2.

[0103]

Moreover, since the three reflective-type displacement detecting sensors 50, 51, and 52 are only provided on two sides of the edge of the position 33b which the LCD substrate 2 should be placed on the stage 9 for substrate installation in the actually installed substrate check device 1, like in the above-described first embodiment, there is no need to adjust the displacement detecting sensors 50, 51, and 52 at the time of assembly of the substrate check device 1, and the cost price of the whole device can be reduced by just that much.